Newport's Photon Tamers at Work: Newport GTS High Precision Linear Stage Scans Ultrafast THz Pulse

The Terahertz (THz) region of the electromagnetic spectrum offers researchers an opportunity to probe materials in new and exciting ways. Using Terahertz Time Domain Spectroscopy (Thz-TDS), the unique responses of materials to Terahertz radiation not only provides a method for material characterization but also an opportunity to better understand behaviors of complex phenomena such as ferromagnetism.

A Newport customer at the Fritz Haber Institute in Berlin, Germany is exploring the physical processes and phenomena at the Terahertz (THz) frequency region more deeply. The customer's research is focused on efficient generation of THz radiation by means of femtosecond laser pulses and the manipulation of these pulses in photonic structures such as waveguides.

A THz pulse can be generated by Electro-optic Rectification (EOR). This is done in an electro-optic medium via difference-frequency mixing of various Fourier components of the driving optical spectrum. The same THz field can be detected using an electro-optic crystal, ZnTe [1-4]. To characterize the generation of ultra short THz pulses, a scanning system is applied as shown in Fig. 1.

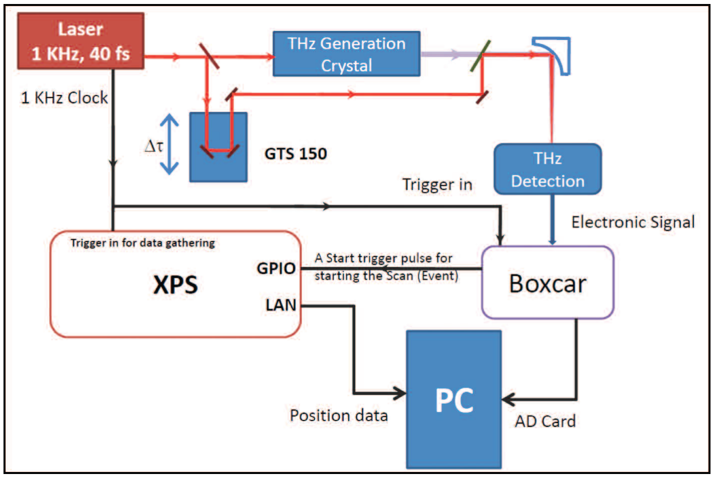

Fig. 1: Schematic of a THz scanning system (Courtesy of Fritz Haber Institute, Berlin, Germany)

In the setup, a THz pulse is generated using difference frequency mixing in ZnTe from a femtosecond laser pulse (40 fs width, running at 1 kHz repetition rate). An optical delay line technique is used to detect the THz pulse, using another femtosecond pulse delayed in time. A customized Newport GTS70 High Precision Linear Stage is used in the delay line setup (Fig. 2), offering superior Minimum Incremental Motion (MIM) of 0.1 µm and outstanding bi-directional repeatability of 0.2 µm. The GTS70 has been modified with a wider top plate and added holes to provide a flexible mounting for various opto-mechanical components.

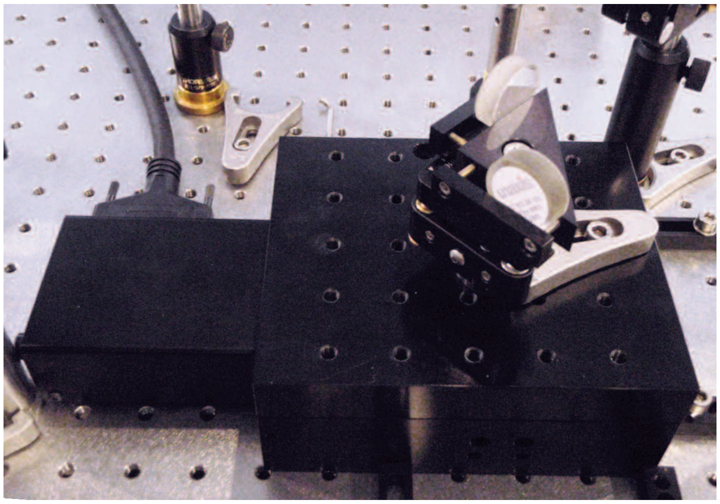

Fig. 2: Custom GTS70 high precision linear stage in the THz scanning system

The THz pulse is scanned continuously in time with the GTS stage and an XPS Universal Motion Controller is used to gather position data with each pulse. Each laser pulse is synchronized with the position of the stage while in motion. This is achieved using the XPS controller as shown in Fig. 1. A 1 kHz electronic clock signal from the THz detection system is used to trigger the scanning event through the Boxcar device (a sampling instrument with trigger inputs and outputs for input signals integration and processing) sending a single start trigger pulse to the XPS.

As the stage is moving in the forward direction, the Electro-Optic Sampling (EOS) data and the stage position information are gathered and transferred to the PC. Once the forward motion is complete, another start trigger pulse is sent to the GPIO (General Purpose Inputs and Outputs) of the XPS, starting the reverse motion. With extensive I/O functions and high speed data acquisition of 10 kHz, the XPS controller is an ideal platform for data collection. The XPS also ensures that stage motion is precisely synchronized, allowing the user to verify the plot of the THz signal versus the time delay in the PC, as shown in Fig. 3. The measured signal for each setting of the time delay allows the investigation of nonlinear effects and the characterization of various electro-optic materials.

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Newport offers various motorized positioning solutions for optical delay line applications. For more information, please contact Newport sales and application engineers at tech@newport.com.

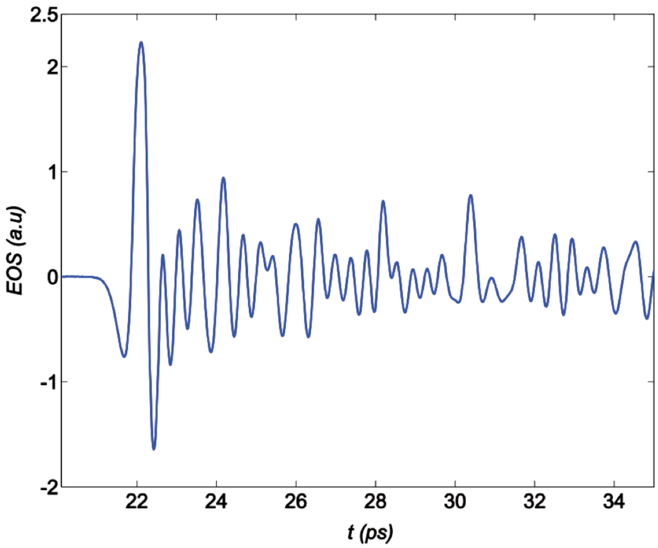

Fig. 3: THz signal versus time delay measurement (Courtesy of Fritz Haber Institute, Berlin, Germany)

References:

1. A. Nahata, Aniruddha S. Weling, and T. F. Heinz, "A wideband coherent terahertz spectroscopy system using optical rectification and electro-optic sampling"Appl. Phys. Lett. 69, 2321-2322 (1996).

2. Q. Wu and X.-C. Zhang, ''Free-space electro-optic sampling of terahertz beam,'' Appl. Phys. Lett. 67, 3523–3525 (1995)

3. Q. Wu and X.-C. Zhang, ''Ultrafast electro-optic field sensor,'' Appl. Phys. Lett. 68, 1604–1606 (1996).

4. A. Nahata, D. H. Auston, and T. F. Heinz, ''Coherent detection of freely propagating terahertz radiation by electrooptic sampling,'' Appl. Phys. Lett. 68, 150–152 (1996).

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